



RECEIVED

FEB 01 1993

MONTANA DEPARTMENT OF HEALTH  
AND ENVIRONMENTAL SCIENCES  
SOLID AND HAZARDOUS WASTE BUREAU

January 29, 1993

Ms. Pat Potts  
Dept. of Health and Environmental Services  
Solid and Hazardous Waste Bureau  
836 Front Street  
Helena, MT 59620

Subject: Proposed Work Plan for Site Characterization  
Mr. M Landfill Site  
Lewistown, Montana

Dear Ms. Potts:

In accordance with our recent conversations we have prepared a work plan for characterization of the above referenced site. The plan has been prepared in general accordance with ARM 16-765, Subchapter 7.

We have gathered all readily available data with respect to the site and interviewed the owner/operator of the facility, Mr. Marvin Mintyala. Please note that published geotechnical information for the Lewistown area is limited and that we have utilized our own files to the extent possible. The work plan is structured with the reader/user in mind and does not follow the outline presented in Subchapter 7 *per se*.

If you have any questions or need further data please contact us.

Very truly yours,  
ABENAKI GEOENVIRONMENTAL, INC.

Robert W. Gillespie, P.E.  
Principal Geotechnical Engineer

RWG:mah

cc: Marvin Mintyala (1)







RECEIVED

FEB 01 1993

MONTANA DEPARTMENT OF HEALTH  
AND ENVIRONMENTAL SCIENCES  
SOLID AND HAZARDOUS WASTE BUREAU

January 29, 1993

Ms. Pat Potts  
Dept. of Health and Environmental Services  
Solid and Hazardous Waste Bureau  
836 Front Street  
Helena, MT 59620

Subject: Proposed Work Plan for Site Characterization  
Mr. M Landfill Site  
Lewistown, Montana

Dear Ms. Potts:

In accordance with our recent conversations we have prepared a work plan for characterization of the above referenced site. The plan has been prepared in general accordance with ARM 16-765, Subchapter 7.

We have gathered all readily available data with respect to the site and interviewed the owner/operator of the facility, Mr. Marvin Mintyala. Please note that published geotechnical information for the Lewistown area is limited and that we have utilized our own files to the extent possible. The work plan is structured with the reader/user in mind and does not follow the outline presented in Subchapter 7 *per se*.

If you have any questions or need further data please contact us.

Very truly yours,  
ABENAKI GEOENVIRONMENTAL, INC.

Robert W. Gillespie, P.E.  
Principal Geotechnical Engineer

RWG:mah  
cc: Marvin Mintyala (1)





**PROPOSED WORK PLAN  
FOR  
SITE CHARACTERIZATION  
OF  
MR. M LANDFILL  
LEWISTOWN, MONTANA**

**TO  
MONTANA DEPT. OF HEALTH AND ENVIRONMENTAL SERVICES  
SOLID AND HAZARDOUS WASTE BUREAU  
HELENA, MONTANA**

**PREPARED  
BY  
ABENAKI GEOENVIRONMENTAL, INC.  
LEWISTOWN, MONTANA**

**JANUARY 1993**





## INTRODUCTION

The purpose of the accompanying work plan is to provide the rationale for characterizing the Mr. M Landfill site in Lewistown, Montana. The work plan has been designed to utilize those data which are both available and valid, and to incorporate and correlate them with new data which are generated by the work proposed herein. The regulations promulgated in Subchapter 7 have been followed in the general case but deviations were necessary to accommodate the available data. Protocols for sampling, preservation, and transportation will be those recommended by NWWA and EPA.

The regulations contained in Subchapter 7 require that the site be characterized with respect to disposal, surficial geology, geohydrology, and hazards. Potential problems relating to the operation of the landfill and its environs must be identified and mitigation techniques developed as appropriate. Any situations involving hazardous wastes and/or substances must be identified and corrected.

The work plan is presented in sections which logically follow one another. Data are tabulated wherever possible for ease of reference and understanding, logic for deviations or alterations to the regulations are explained in detail.

## BACKGROUND

The landfill is located on the north side of Hwy. 200 approximately 3 miles east of Lewistown, Montana; a locus map is provided on Figure 1. More specifically, it is an approximately 49 acre parcel located in the SW1/4 of Section 8, Township 15N, Range 19E. The site has been operated as a landfill since the mid 1970's and was purchased by Marvin and Sandra Mintyala in the early 1980's. The waste stream appears to be exclusively residential and light commercial with occasional acceptance of junk cars. Observed wastes were high in paper and plastic content with metals limited to food cans and the like. Few aluminum cans were observed at any location with the exposed working area. White goods and ferrous metals are accepted and stockpiled for transfer to scrap dealers and other appropriate disposal facilities.

*30 ac.  
24 SE  
? CADOT Site  
(was active)*

Records review show that no monitoring or other environmental observations have been conducted on a regular basis at the facility. Several spot checks by DHES personnel are on file but contain only limited information.

The site characterization which is required by regulation has been requested by DHES in order to bring the Mr. M Landfill in compliance with existing statutes. The





characterization assumes that the facility will remain a disposal for household and domestic type wastes. Special and/or hazardous wastes are specifically excluded from this site unless the proper investigations, designs, permits, and construction techniques are implemented.

## SITE CHARACTERISTICS

### Surface

The landfill is situated in a small south facing depression or half bowl. It is operated as both a trench and open disposal facility depending on the area being used. At the time of our visit in late November 1992 waste was being placed in the northwest section of the site. Placement was commensurate with the type of operation in that the waste is dumped, spread and compacted with a dozer, and covered with local borrow which is also spread and compacted with a dozer. Lift thicknesses are generally less than two feet.

*How deep are the trenches?*

Topographically the site is located on a south facing slope which rises to the north and northeast toward the foothills of the Judith Mountains. The overall drainage area is in excess of 4 square miles and appears to <sup>be</sup> drained by Boyd Creek which travels southwest out of the mountains past the southern edge of the site and into the prairie surrounding Lewistown. Numerous subdrainages are included within the basin as illustrated on Figure 2 attached. The landfill is straddles a small ridge or promontory as illustrated on Figure 2. Most of the fill is placed along the crest, and the south and southeastern flanks of the ridge. We also noted a small (less than 2 acres) landfill area which has undergone closure on the south side of the active area. According to Mr. Mintyala the area contains domestic type waste from the Lewistown area.

*Doesn't this just increase slopes for runoff?*

A large earth cut is located along the northern property line and is accessed by a haul road which travels west and north. Daily cover is extracted from this location and transported to the active work area. The face is, in reality, a high wall in the bedrock underlying the site. More detail is provided in subsequent sections.

*Stormwater MPDES permit*

Surface water runoff is directed to two roughly parallel drainages which border the landfill. The flow exits through two culverts in the old railroad bed and flows along Hwy. 200 until it enters Boyd Creek about 1500 feet west of the site. Surface runoff from the landfill proper is collected in shallow ditches along the toe and routed to a detention pond just north of the office building near the center of the site. Field observations show the system is reasonably effective although it was not engineered according to Mr. Mintyala.





If flows are large, a small spillway routes flow from the first pond into a second. A spillway in the second pond acts as an outlet to the western most natural drainage. Silt from both ponds is removed on a regular basis and returned to the landfill area for use as cover.

Several minor seeps were noted at the southern toe of the landfill but flow was insufficient to develop a quantitative estimate. Coloration was light brown to brown orange indicating relatively high iron contents and oxidation of the same. Their source is probably precipitation, and condensation from within the landfill mass. At this time we perceive nothing abnormal or pernicious with the situation.

### Subsurface and Ground Water

As presented earlier, little published information is available for the general Lewistown area. A cursory site investigation was made by Botz (1979) which developed limited but useful data with respect to surficial geology; the report is attached as Appendix A. Water well logs were obtained from Montana Bureau of Mines and Geology which provided data on bedrock geology and ground water levels. Reconnaissance mapping was accomplished during our November 1992 site visit.

Surficial soils are probably residual in origin, being derived from the underlying siltstones and sandstones. Thickness is highly variable and least on ridge tops because of aeolian action and erosion by runoff. By the Unified Soil Classification System, the soils are usually SM, ML, and occasionally SC. They are high in calcium, iron, and carbonates, and can deposit carbonate salts under the right conditions. Excellent exposures are provided by the borrow operations for daily cover.

Bedrock is the Cretaceous age Kootenai Formation. The high wall exposure shows about 30 to 35 feet of silty, fine grained, poorly cemented or indurated sandstone underlain by a soft to friable, moderately plastic shale or claystone. At the time of our site visit, the shale was exposed in the road leading to the borrow at the base of the high wall. Water well logs show that the shale layer is apparently continuous over a significant part of the area east of Lewistown. Lithology as developed from the logs consists of sandstones underlain by the aforementioned shale layer followed by alternating layers of sandstone and shale. Water is derived from a "white" or "gray" sandstone unit at depths of 200 to 350 feet. Water is under excess pressure and rises to levels which are 40 to 100 feet below ground surface. Approximate locations based on well log descriptions and/or field reconnaissance are plotted on Figure 3. Elevations of ground water are also shown. The data show that the aquifer is the sandstone unit and that it is confined. The







data also show that the gradient is to the southwest with a slope on the order of 0.02 to 0.05. <sup>rel. to</sup> The gradient should be considered as regional for the time being because of the sparseness of data. Localized gradients are possible because of the steep topography. The recharge area is probably in the foothills of the Judith Mountains or the Judith Mountains themselves. Well yields are typically less than 10 gallons per minute and water quality has been classified as fair to good. We could not locate any reports of contamination.

vs subsurface  
water level  
elect.

The data strongly suggest that the aquifer is protected by the shale layer at depths of 25 to 50 feet. While we would not use the term aquiclude it certainly classifies as an aquitard. Near surface ground water appears to be ephemeral and related to seasons and/or prolonged precipitation events. Botz observed water in one test pit and set a monitoring well to provide an observational point. According to Mr. Mintyala the well has been dry since its installation. Our field observations lead us to believe that near surface ground water is extremely limited.

### WORK PLAN

The following work plan has been developed to provide the data requested in 16.14.703 of the ARM. Succinctly, the purpose of the work is characterize the site from a geotechnical standpoint and use those data to design a short and long term monitoring plan for the protection of the environment. Line item descriptions and "bullets" have been use to allow the reader to grasp and digest the essence of the text without having to wallow in excess verbage.

### Safety

Our field visit suggests that hazardous materials will not be an issue during the performance of the field portion of the work plan. However, Level C equipment will be on hand for all personnel during the field phase, and the site will abandoned in the event a hazardous or potentially hazardous situation is encountered. If work continues beyond that point a formal health and safety program will be developed for use on site.

? Explosive gases while drilling &/or excavating.

### Surface

Surficial work is divided into site plan development and geotechnical work. The proposed scope is as follows:





1. review available low and high altitude aerial photography for the purpose of fault trace and lineament analysis. While none are expected to be found, we believe it to be the prudent course of action.
2. develop a site plan using the aerial photography and USGS quadrangle maps as bases. The plan will be at a scale of approximately 1"=200".
3. conduct reconnaissance surficial and bedrock mapping of the site proper and the surrounding area for a distance of at least 1,500 feet. The data will be displayed on the aforementioned base plan. Emphasis will be placed on structure, stratigraphy, morphology, and potential aquifer recharge zones. The low level photographs will be used for correlative purposes.
4. evaluate all acquired field and office data to determine relationships between topography, structure, and morphology as they relate to the geohydrologic regime. Emphasis will be placed on the influences exerted by the landfill and its continued operation. Locations for subsurface explorations will be selected during this task.
5. prepare an interim report for use by the Bureau and Mr. Mintyala presenting our findings, and confirming or altering the balance of the work plan.

← feet

can't tentative  
excavation  
locations be supplied  
now?

### Subsurface

The subsurface section of the work plan is predicated on the data we have acquired to date. We reserve the right to alter the scope as dictated by field conditions but will notify the Bureau immediately of any changes. The regulations require approximately 25 subsurface explorations for this site. However, the well data already gathered are within the same section and should be considered valid for the purposes of this study. Therefore, 17 locations within the landfill site proper are proposed for exploration. Work plan items as follows:

6. excavate, log, and sample 12 test pits at locations generally conforming to the anticipated perimeter of the landfill. The pits

23 boreholes  
7 borings

No

No 23

No 8  
300' from  
limits of  
waste filling  
active or  
proposed?





will be logged and sampled by our geotechnical engineer in general accordance with ASTM and USCS recommendations. Representative soil samples will be preserved in clean 1 liter glass jars for transport to our geotechnical laboratory. The pits will be logged for lithology, structure, and evidence of ground water. In the event ground water is encountered in a test pit, the pit will be allowed to remain open in order to allow the ground water to stabilize. The level will be measured and referenced to a permanent benchmark, and a grab sample will be taken using a sterile bailer. Filtering and preservation will be in accordance with NWWA and EPA protocol.

why for what?  
No samples required, unless sieve or lab Ks?

for what purpose?

7. drill, log and sample 5 monitoring wells at the locations shown on Figure 2. The borings would be drilled using rotary techniques with either an air or water matrix. Cuttings would be collected at frequent intervals at the discharge orifice and examined by our geotechnical engineer for soil or rock type and evidence of ground water. All samples will be scanned for volatile organic compounds using an Hnu HW-101 photoionization detector. Any sample which exhibits a positive reading of greater than 2 ppm will be preserved in a sterile 40 ml VOA vial and refrigerated for transport to an analytical laboratory. The rig and its tools will be cleaned prior to entering the site using steam cleaning and appropriate soaps and rinses. Similar cleanings will be accomplished in the event that contamination is encountered during the drilling process.

air?  
not mud  
see ASTM 16.14.705(2)

explosimeter - methan

chlorinated solvents?

2 ppm low  
Not required under State rules

No decon after each boring  
16.14.705(3)  
TEGD

8. establish monitoring wells in each bore to allow for ground water sampling and level measurements. Table 1 below provides a summary of the anticipated depths and screen lengths.

or piez, if just wells





TABLE I

## MONITORING WELL SUMMARY

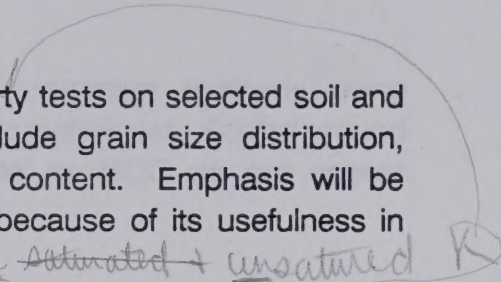
| Well No. | Depth                     | Screen Interval                 |
|----------|---------------------------|---------------------------------|
| 1        | top of shale              | top of shale to 10 ft. above    |
| 2        | top of shale              | top of shale to 10 ft. above    |
| 2a       | 10' below bottom of shale | bottom of shale to 10 ft. below |
| 3        | top of shale              | top of shale to 10 ft. above    |
| 3a       | 10' below bottom of shale | bottom of shale to 10 ft. below |
| 4        | top of shale              | top of shale to 10 ft. above    |
| 4a       | 10' below bottom of shale | bottom of shale to 10 ft. below |
| 5        | top of shale              | top of shale to 10 ft. above    |

The wells will be constructed in accordance with DHES and NWWA requirements. Elevations of ground surface, top of casing, and top of well will be determined by level survey tied to NGVD datum.

9. Develop wells, equilibrate, purge and sample all wells in accordance with EPA and NWWA protocols to obtain a baseline sample suite from which to design the future sampling and analysis program. Sterile disposable bailers will be used which obviates the need for a rinsate blank sample. Preservation and filtration will be in accordance with the same protocols unless field conditions dictate that other protocols are more appropriate.
10. sample any seeps from the landfill using grab or composite methods.
11. conduct analytical tests on the recovered samples for the parameters listed in Table 1 of ARM 16.14.706 unless field observations and measurements suggest otherwise.





12. conduct index and physical property tests on selected soil and rock samples. Tests would include grain size distribution, Atterberg limits, pH, and organic content. Emphasis will be placed on grain size distribution because of its usefulness in estimating permeability. *insitu saturated + unsaturated* 

13. conduct in situ permeability tests in each monitoring well using the slug test method unless sufficient water is available for a drawdown test.

### Evaluation of Geotechnical Data

The acquisition of data is for the express purpose of characterizing and designing a ground water monitoring program for environmental protection. The following tasks and deliverables are anticipated:

13. evaluate all acquired field, office, and laboratory data with respect to the landfill and its influence on the environment, with emphasis on the geohydrologic regime. More specifically, we would address:

- local hydrology in and around the landfill. *TR55* methodology should be adequate. 
- local and regional geohydrology including bedrock and surficial or near surface aquifers. To the extent possible, recharge zones would be defined and a water balance would be calculated. Values of transmissivity, hydraulic conductivity, gradient, porosity, and storativity would also be generated within the limitations of the data.
- influences of the landfill on surface and ground water flows. Lateral and vertical expansions of the landfill will be included the evaluations.

14. design a ground monitoring plan which will provide the basis for continual evaluation of landfill impacts, if any, on the ground water system(s). The plan would include sampling frequency, changes in standard protocol for sampling if needed, analytic





parameters, and recommended evaluation methods using appropriate statistical or probabilistic techniques. Formal ground water models such as MODFLOW or MOC do not appear necessary at this writing.

15. provide deliverables which include but are not necessarily limited to:

- base site plan at 1"=200'.
- surficial and bedrock maps at the same scale as the base map.
- ground water contours of the surficial or near surface aquifer and the bedrock aquifer.
- logs and monitoring well construction data using Unified Soil Classification System and ASTM descriptor methods.
- an engineering report describing our findings, conclusions, and recommendations. The latter could include additional ground water monitoring or surface water sampling locations.
- a ground water sampling plan which would encompass frequency, parameters, and data evaluation techniques. The plan will include the formalities of a Sampling and Analysis Plan or SAP.

### CLOSURE

The work performed in this study will be conducted by and under the direction of Robert W. Gillespie, P.E. He will be assisted by Cynthia A. Thayer and Mark A. Weritz, P.E., both of whom have directly applicable landfill experience. Energy Labs of Billings, Montana will provide analytical services, and survey services will be accomplished by Civil Design Solutions of Lewistown, Montana. The work will conform in all respects to the requirements of Subchapter 7 and the standard of care exercised by other professional practicing in the general area.

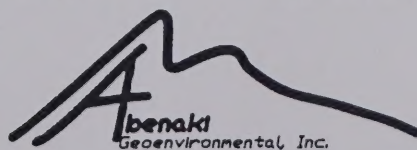






JANUARY 1993

PROJECT NO. 100-06



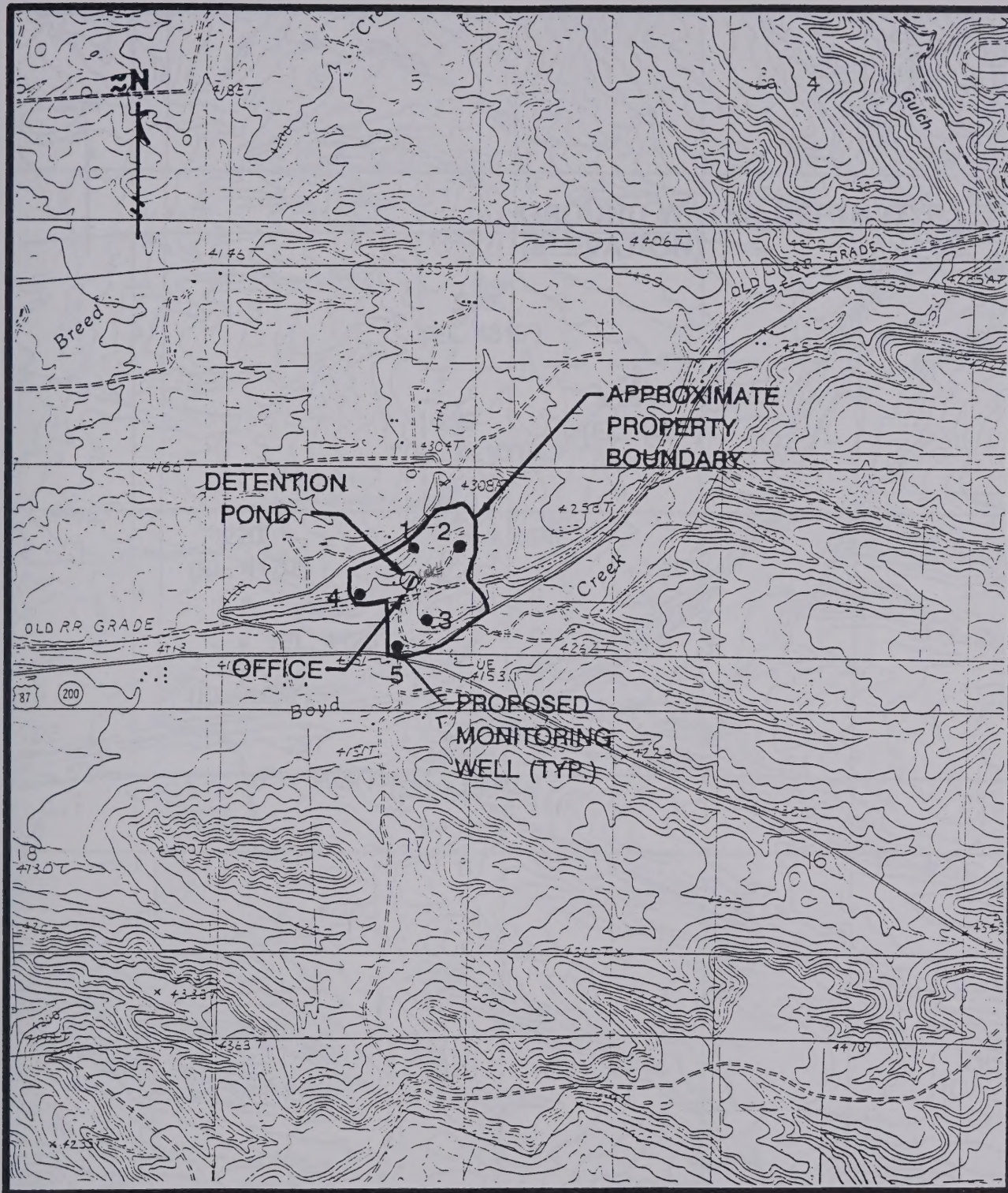
P.O. Box • Lewistown, Montana 59547 • (406) 538-5800

FIGURE 1

Copyright © 1993 Abenaki Geoenvironmental, Inc.







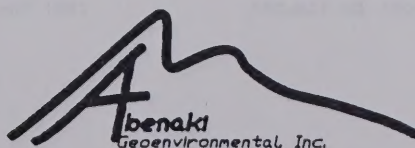
SCALE 1" = 2000' (APPROX.)

USGS PINE CREEK, MT QUAD (1985)

# SITE PLAN WORK PLAN FOR SITE CHARACTERIZATION MR. M LANDFILL LEWISTOWN, MONTANA

JANUARY 1993

PROJECT NO. 100-06



P.O. Box • Lewistown, Montana 59547 • (406) 538-5800

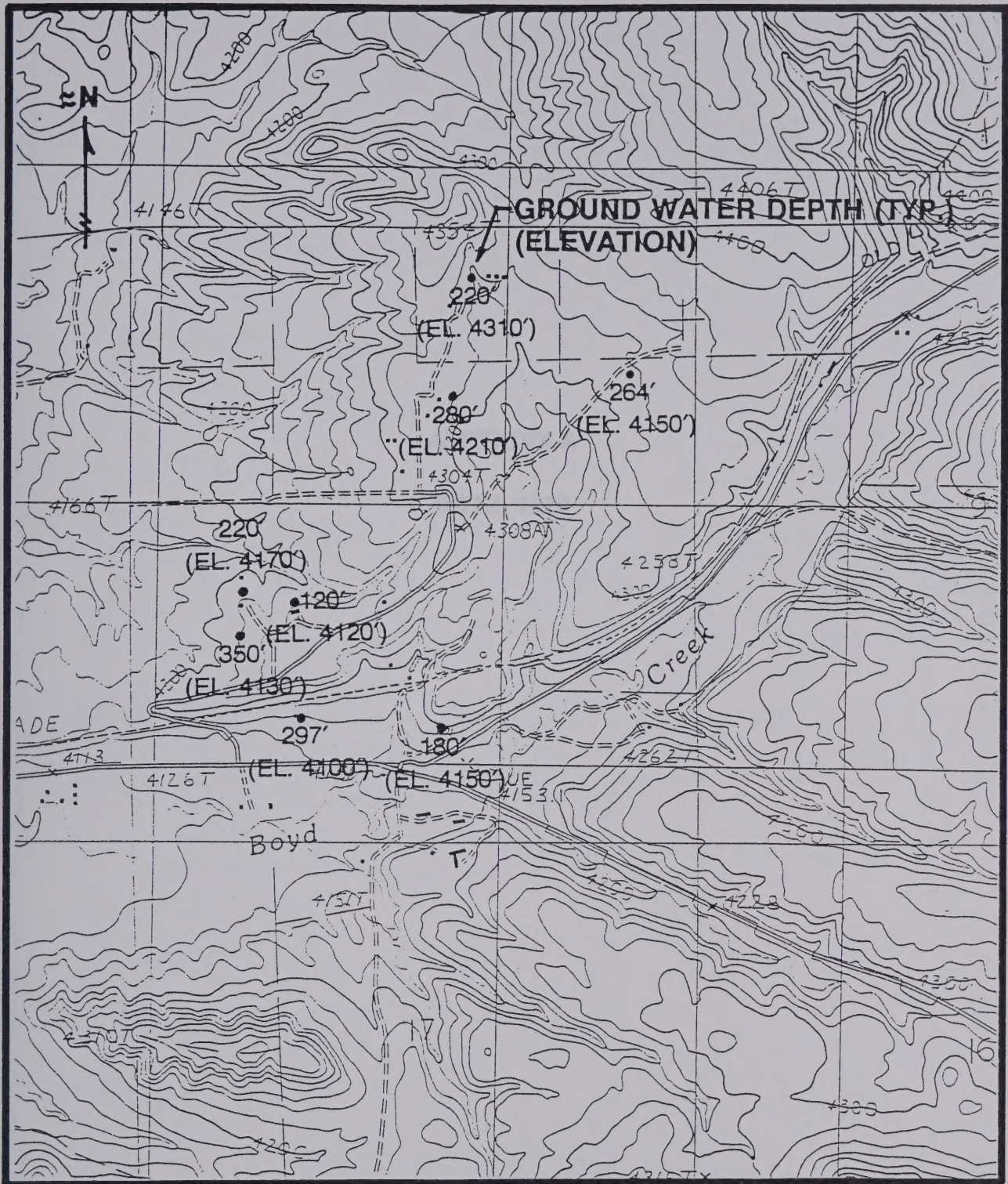
FIGURE 2

Copyright © 1993 Abenaki Geoenvironmental, Inc.









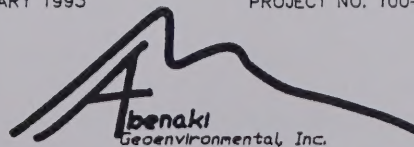
SCALE 1" = 2800' (APPROX.)

USGS PINE CREEK, MT QUAD (1985)

**WELL LOCATION AND GROUND WATER PLAN  
WORK PLAN FOR SITE CHARACTERIZATION  
MR. M LANDFILL  
LEWISTOWN, MONTANA**

JANUARY 1993

PROJECT NO. 100-06



P.O. Box • Lewistown, Montana 59547 • (406) 538-5800

**FIGURE 3**

Copyright © 1993 Abenaki Geoenvironmental, Inc.







November 12, 1979

Mr. John Robertson, Chief  
Public Health Department, Lewistown  
1400 Broadway Avenue, Suite 2  
Lewistown, Montana 59044

## APPENDIX A

Dear Sir:

## BOTZ, 1979

Enclosed is my report on the hydrogeological conditions at the well site located near the town of Lewistown, Montana. The report was prepared for the Lewistown Public Health Department. The report includes a description of the well, a description of the hydrogeological conditions, and a description of the results of the investigation. The report also includes a list of references and a list of figures. The report was prepared for the Lewistown Public Health Department. The report includes a description of the well, a description of the hydrogeological conditions, and a description of the results of the investigation. The report also includes a list of references and a list of figures.

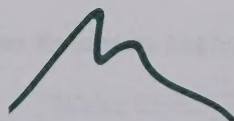
I have enclosed this report with the report on the hydrogeological conditions at the well site located near the town of Lewistown, Montana. The report was prepared for the Lewistown Public Health Department. The report includes a description of the well, a description of the hydrogeological conditions, and a description of the results of the investigation. The report also includes a list of references and a list of figures. The report was prepared for the Lewistown Public Health Department. The report includes a description of the well, a description of the hydrogeological conditions, and a description of the results of the investigation. The report also includes a list of references and a list of figures.

Please call me if you have any questions on this report or need any further information.

Sincerely,  
Map

Robert L. Botz, P.E.  
Hydrogeologist-Engineer

Map  
Enclosure







December 12, 1979

Mr. Duane Robertson, Chief  
Solid Waste Management Bureau  
1400 Eleventh Avenue, Suite A  
Helena, Montana 59601

Dear Duane:

Enclosed is my report describing hydrological conditions at two solid waste disposal sites near Lewistown, Montana. Results of this examination indicate portions of each site contain groundwater within 10 feet of the ground surface. Other portions of each of these sites, however, appear to meet all hydrological criteria for Class II sites.

I have delayed sending this report until I received site sketch maps. I have not as yet received these so I have developed rough sketch maps based on my site visits. Good plan maps are still needed for both these sites. I have some photos of the sites that I will send to you when they are processed.

Please call me if you have any questions on this report or need any further information.

Yours truly,

*Max*

Maxwell K. Botz, P.E.  
Hydrologist-Engineer

*Map*

MKB:bd  
Enclosure

RECEIVED

MONTANA DEPARTMENT OF HEALTH  
AND ENVIRONMENTAL SERVICES  
SOLID WASTE DIVISION

Ground Water Development

Geotechnical Investigation

Water Resources Engineering

Mining Hydrology

Water Quality

Water Rights





HYDROLOGICAL ASSESSMENT OF  
TWO SOLID WASTE DISPOSAL SITES NEAR  
LEWISTOWN, MONTANA

for

Mr. Duane Robertson, Chief  
Solid Waste Management Bureau  
1400 Eleventh Avenue, Suite A  
Helena, Montana 59601

by

HYDROMETRICS  
1300 Cedar Street  
Helena, Montana 59601  
406/443-4150

December 12, 1979





HYDROLOGICAL ASSESSMENT OF  
TWO SOLID WASTE DISPOSAL SITES NEAR  
LEWISTOWN, MONTANA

In November 1979, at the request of the Montana Solid Waste Management Bureau, two solid waste disposal sites near Lewistown, Montana were examined. Objectives of this examination were to appraise hydrological conditions at these sites and to determine if they meet all requirements for Class II solid waste disposal sites under the rules of the Montana Solid Waste Management Bureau. For solid waste disposal at Class II sites, Montana rules (Section 16-2.14(8)-S14315) require that groundwater be a depth of at least 10 feet beneath the bottom of the proposed landfill site and that permeability of the material underlying the site be less than  $10^{-3}$  (2.83 ft/day). The primary focus of these site examinations was to determine existing groundwater conditions.

Field trips were taken to Lewistown to examine these solid waste sites on November 7, 8, 10 and 21, 1979.

CADOTTE DISPOSAL SITE

The Cadotte disposal site is approximately 2 miles east of Lewistown, Montana along Highway 87 (T15N,R18E,Section 7). This site is on a very small south-facing ephemeral tributary to Boyd Creek. This drainage is bowl shaped and is about 300 feet in diameter. Low hills surround the site and, in past years, portions of the bottom of the drainage have been used for disposal of solid wastes. It was reported by the site owner, Mr. Don H. Cadotte, that the site had a deeply incised stream channel which was backfilled with solid wastes. He also reported that the upper end of this drainage was used to bury wastes by





excavating deep trenches, filling with waste, and covering with soil.

A total of four backhoe pits were dug at this site (Figure 1) to determine subsurface geological conditions and depth to groundwater. The site appears to be underlain by dark-colored marine shales of the Colorado Formation of Cretaceous geological age. Overlying the shale bedrock is a thin mantle of light brown, stony, clayey silt.

The first test pit was dug on November 7, 1979 near the southern end of the proposed disposal site about 90 feet north of the old railroad center line. (See Figure 1.) This area is underlain by approximately three feet of compacted solid waste consisting primarily of wood and metal products. Underlying the solid waste material is a very firm, dark-colored, moist to very moist claystone. A blocky shale typical of the Colorado Formation and harder than the claystone was encountered at a depth of 7 feet. This first test pit was completed at a total depth of 13 feet in a very firm, dense, gray shale. The material was very moist but did not appear to contain free water. Approximately 10 minutes after completion of the test pit, groundwater began seeping into the trench at a depth of an estimated 12½-13 feet. Early the next morning (November 8, 1979), groundwater in Test Pit 1 was approximately 10 feet below the ground surface.

Test Pit 2 was dug on November 7, 1979 approximately 125 feet southwest of Test Pit 1 and near the upstream toe of the abandoned railroad embankment (Figure 1). Test Pit 2 contains approximately 2 feet of solid wastes and is underlain by very firm, blocky, dark-colored shale. At a depth of 10 feet, a slight amount of groundwater seeped into the hole after completion of excavation. On the following day (November 8, 1979), the water surface in Test Pit 2 was 8 feet below the ground surface.





After finding groundwater in the lower end of the proposed disposal site, two additional test pits were dug in the north-west portion of the site (Figure 1). Both these pits were dug to a depth of over 10 feet into a shale bedrock consisting of very firm, blocky shale which varied in color from brown to gray. These test holes were dug under the supervision of Bob Childers, sanitarian from Lewistown, on November 8, 1979. On November 10, 1979 no water was observed in these holes by M. K. Botz of Hydrometrics.

Bedrock at the Cadotte site is estimated to have a low permeability (less than  $10^{-3}$  cm/sec) and appears to be transmitting a small quantity of groundwater southward toward Boyd Creek. This groundwater probably is derived from local infiltration on the disposal site and possibly from a small drainage north of the disposal site. The small quantity of groundwater from the Cadotte disposal area is not expected to impact groundwater resources except on and very near the site. It is estimated that the quantity of groundwater moving through the site is very small and chances of any off-site impacts are remote.

Approximately one-quarter mile north of the Cadotte site is a much larger east-west trending drainage. This drainage contained a small quantity of ponded water and several cattail patches, indicating continued wet conditions. This wet area appeared to be higher in elevation than the lower portion of the Cadotte site, and could be a source of groundwater recharge to the site.

The major stream drainage in the area is an estimated 400-600 feet south of the Cadotte site, and has a relatively flat ground surface and is underlain by alluvium of unknown thickness. There is one residence south of the site. This residence uses a drilled well to supply household water. The well is in a 10-12 foot deep pit which was constructed using 48-inch CMP





(corrugated metal pipe). The CMP contains a few slots near the ground surface. Near the bottom of the CMP is the well and pressure tank. The well seal has been modified to accommodate the drop pipe and pump wire. Neither the well nor the CMP is sealed to prevent entrance of surface water or debris.

#### THE MR. M DISPOSAL SITE

This site is approximately 3.1 miles east of Lewistown along Highway 87 in Township 15N, Range 19E, Section 8 and is owned by Mr. Marvin Mintyala. This active site has been used for waste disposal for a number of years. The site is in a small, south facing drainage basin entirely underlain by shales, claystones and sandstones of the Kootenai Formation of Cretaceous geological age. These bedrock strata are nearly horizontal and are reddish brown, yellow, cream and purple, which is typical of this formation. Bedrock is overlain by a thin layer of light brown-colored, silty soil.

A total of 5 test pits were dug on the property by a backhoe to determine subsurface geological and groundwater conditions. A sketch map of the property and backhoe pit locations is shown on Figure 2.

Test Pits 1, 2 and 3 were dug the week of November 19, 1979 under the supervision of Bob Childers. On November 21, 1979 these three test pits were examined and two additional pits were dug. (See Figure 2 for test pit locations.) All test pits were dug to a depth of at least 10 feet and encountered claystone, sandstone and shales of the Kootenai Formation. Generally, the bedrock was weathered near the ground surface and became harder with depth and was relatively fresh in the pit bottoms. Although the soils were very moist in all pits, Test Pit 2 was the only pit that contained groundwater. On November 21, 1979 groundwater was present in Test Pit 2 at





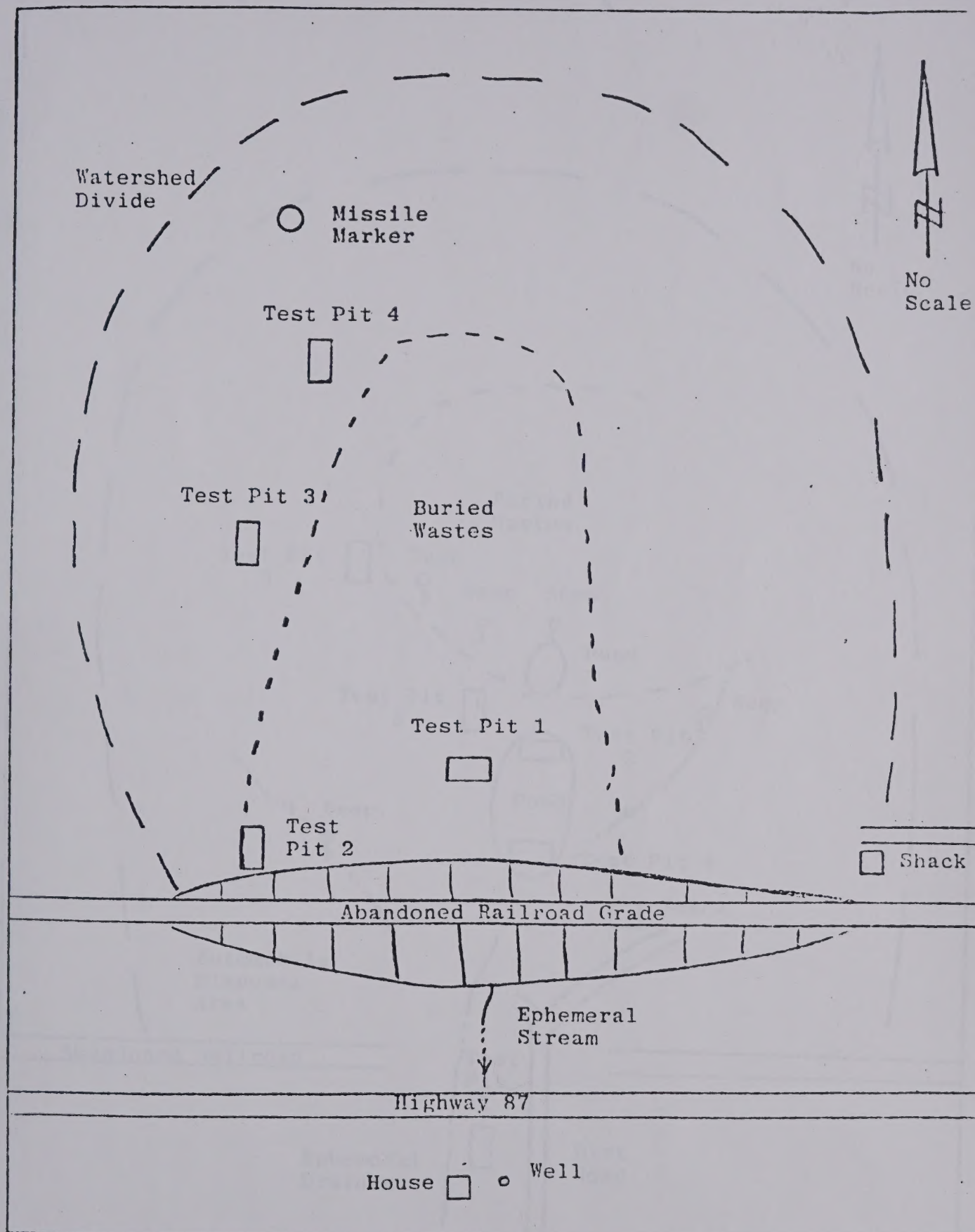


FIGURE 1. SKETCH MAP SHOWING LOCATIONS OF TEST PITS AT THE CADOTTE DISPOSAL SITE





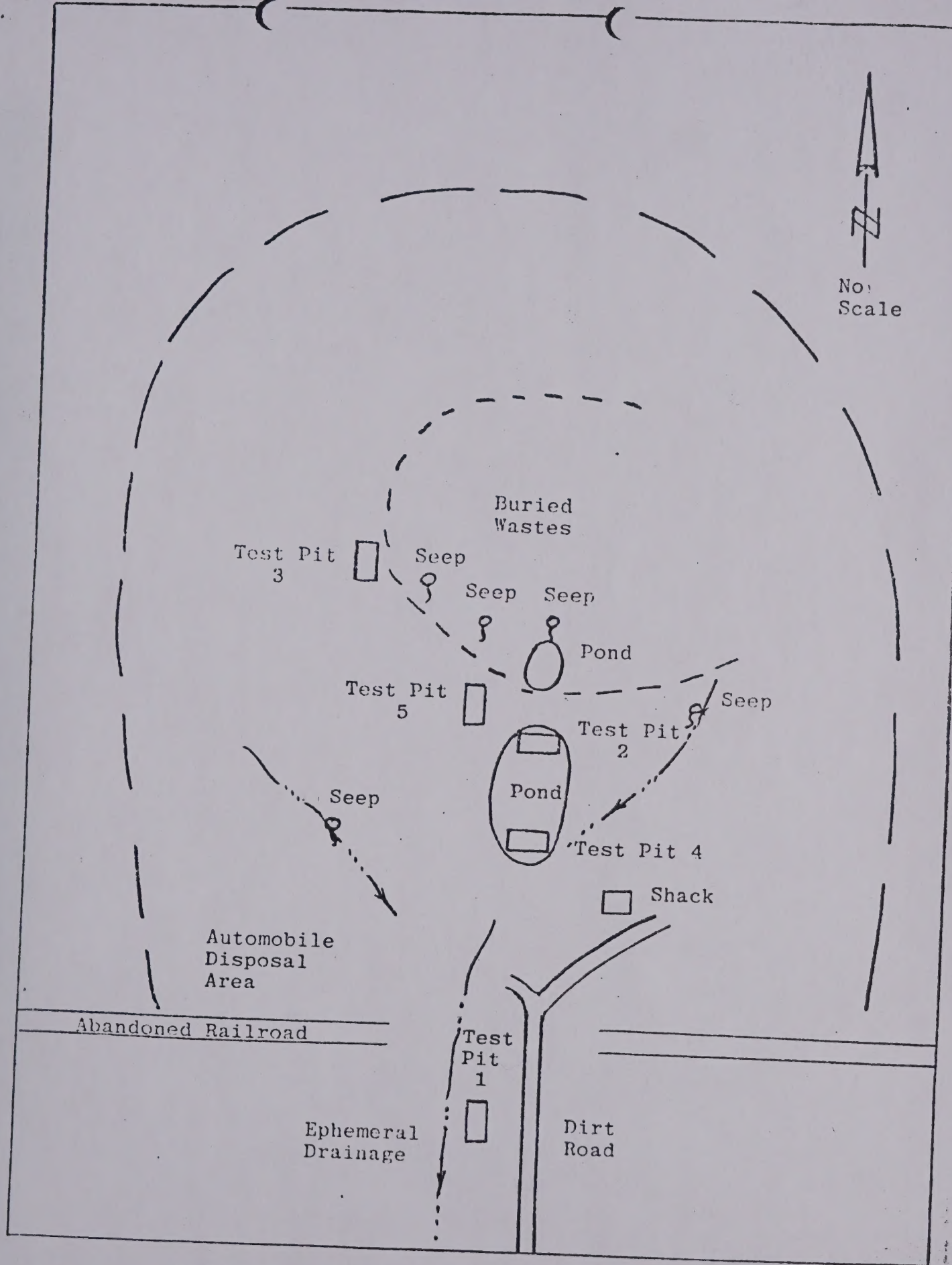


FIGURE 2. SKETCH MAP SHOWING LOCATIONS OF TEST PITS AT THE MR. M. DISPOSAL SITE









